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(54) 【発明の名称】 燃料電池システムの制御装置

(57) 【要約】

【課題】 従来、燃料電池を運転させた場合の方が電気料金と燃料ガス料金との合計が大きくなる場合があった。

【解決手段】 運転スケジュール作成部12は、電気料金の単価の異なる時間で1日を複数の時間帯に分割し、それぞれの時間帯において電気料金の単価と発電単価算出部13で算出した燃料電池1の発電単価とを比較し、電気料金の単価が発電単価と同等の時間帯では蓄電池4を充電するように燃料電池1の運転スケジュールを作成する。

【特許請求の範囲】

【請求項1】 燃料ガスと空気とから電力と熱を発生させ、それぞれを電力負荷と熱負荷とに供給する燃料電池システムにおいて、

燃料電池の発電出力を蓄積する蓄電池と、

1日の運転スケジュールを定める運転スケジュール作成部と、

前記燃料電池の発電出力および前記蓄電池における充電または放電を、前記運転スケジュールに従って制御する制御部とを備え、

前記運転スケジュール作成部は、1日の時間帯を3つの時間帯、すなわち、電気料金の単価が燃料電池の発電単価よりも高い高電気料金時間帯、電気料金の単価が燃料電池の発電単価と同じである等価時間帯、および電気料金の単価が燃料電池の発電単価よりも低い低電気料金時間帯に分割し、前記高電気料金時間帯では、燃料電池は前記電力負荷が消費する量の電力を発電し、前記等価時間帯では、燃料電池は消費されなかった電力を前記蓄電池に充電し、低電気料金時間帯では、燃料電池を停止もしくは第一の運転能力で運転するように、運転スケジュールを作成することを特徴とする燃料電池システムの制御装置。

【請求項2】 燃料ガスと空気とから電力と熱を発生させ、それぞれを電力負荷と熱負荷とに供給する燃料電池システムにおいて、

燃料電池の発電出力を蓄積する蓄電池と、

前記電力負荷が消費する電力量の変化に関する情報を保存する消費電力量保存部と、

1日の運転スケジュールを定める運転スケジュール作成部と、

前記燃料電池の発電出力および前記蓄電池における充電または放電を、前記運転スケジュールに従って制御する制御部とを備え、

前記運転スケジュール作成部は、1日の時間帯を3つの時間帯、すなわち、電気料金の単価が燃料電池の発電単価よりも高い高電気料金時間帯、電気料金の単価が燃料電池の発電単価と同じである等価時間帯、および電気料金の単価が燃料電池の発電単価よりも低い低電気料金時間帯に分割し、前記高電気料金時間帯では、前記燃料電池は前記電力負荷が消費する量の電力を発電し、前記等価時間帯では、前記燃料電池は前記蓄電池を充電するが、ここで充電される電力量は、その後の高電気料金時間帯で使用する消費電力量から燃料電池の最大発電量を減算した電力量であり、ここで、充電した電力量を充電終了直後から使用するよう充電開始時間が定められており、低電気料金時間帯では、前記燃料電池を停止もしくは第一の運転能力で運転するように、運転スケジュールを作成することを特徴とする燃料電池システムの制御装置。

【請求項3】 外部電源からの電気料金体系情報を受信

する通信部を備え、

前記運転スケジュール作成部は、前記電気料金記憶部が前記電気料金体系の情報を取得した時に前記燃料電池の運転スケジュールを作成することを特徴とする請求項1または2記載の燃料電池制御システムの制御装置。

【請求項4】 前記電気料金の単価が、前記高電気料金時間帯では前記燃料電池の発電単価に上限定数を乗じた値よりも高く、前記等価時間帯では、前記燃料電池の発電単価に上限定数を乗じた値以下、かつ前記燃料電池の発電単価に下限定数を乗じた値よりも高く、前記低電気料金時間帯では、前記燃料電池の発電単価に下限定数を乗じた値以下であることを特徴とする請求項1～3いずれかに記載の燃料電池システムの制御装置。

【請求項5】 前記燃料電池を等価時間帯のある期間だけ定格で運転し、前記等価時間帯の後の高電気料金時間帯で前記電力負荷が使用する電力量の一部を充電することを特徴とする請求項1～3のいずれかに記載の燃料電池システムの制御装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は燃料電池を用いた発電システムおよびその運転方法に関する。

【0002】

【従来の技術】燃料電池は、燃料ガスと空気との化学反応により発電し電力供給を行うと同時に、発電の過程で生成する熱をも供給する省エネルギーシステムである。燃料電池の運転方式は従来、燃料電池の発電量を電力負荷の消費電力量にあわせる電力負荷追従運転を行い、消費電力量が燃料電池の定格発電量を越えた場合には商用電源から買電する手法が一般的である。

【0003】しかし、燃料電池による発電単価、すなわち燃料電池が単位電力量を発電するのに要する燃料ガスのコストが、電力会社等から商用電力を買う場合の買電コストより低くしなければ、燃料電池システムを運転させる経済的なメリットはない。現在、例えば東京電力（株）管内の全電化住宅における電気料金の単価は、1日あたり時間帯によって3段階に区分されており、電気料金の単価が最も安い深夜時間帯と最も高い昼間時間帯との料金格差は、夏場で5倍以上にもなる。一方、燃料ガスのコストと燃料電池の発電効率とを考慮すると、燃料電池の発電単価は、深夜時間帯の電気料金の単価と昼間時間帯の単価の間の値になる。よって、深夜など電気料金の単価が安い時間帯に燃料電池を運転しても経済的なメリットが無いのである。

【0004】また、燃料電池の発電量を電力負荷に追従させることは困難なのが現状である。燃料ガスの供給量を制御して燃料電池の発電量を目標の制御値に収束させるのには数分オーダーの時間遅れが生じるからである。このような問題に対処する技術として、蓄電池を用意し、消費電力量が減少した時は蓄電し、消費電力量が増

加した場合は放電して、電力負荷の消費電力量が変化しても極力燃料電池の発電量を一定に保持するものがある。例として特開平6-325774号広報の技術がある。

【0005】図6に特開平6-325774号広報に記載された技術の構成図を示す。101は燃料電池、102は燃料電池の出力である直流電力を交流電力に変換するインバータ、103は直流電力を充電する蓄電池である。110は制御装置で、制御部111を持つ。120、121はそれぞれ電力負荷、給湯負荷、また、131、132、133は制御部111より指令を受けて動作するスイッチである。150は外部電源で、電力会社に相当する。

【0006】以下にその動作について説明する。燃料電池101は発電量一定の運転をしており、電力負荷120の消費電力量が減少すると、スイッチ131を接続して余った電力を蓄電池103に充電する。逆に電力負荷120の消費電力量が増加すると、スイッチ132を接続して蓄電池103を放電し電力負荷120に供給する。なお、蓄電池103の蓄電量が一杯になった場合、あるいは蓄電量が枯渇した場合には、制御部111は燃料電池の発電量が減少あるいは増加するように制御信号を出力する。

【0007】また、制御部111はスイッチ133を接続する指令を出し、割安な夜間電力を外部電源150より購入し蓄電池103に充電する。

【0008】

【発明が解決しようとする課題】しかしながら、上述した燃料電池システムの制御装置では、燃料電池の発電単価と電力会社等の電気料金体系に基づき時間帯で変化する買電コストとの比較がなされておらず、燃料電池を運転させた場合の方が電気料金の単価が高くなる場合があるという問題があった。例えば、電気料金の単価が安い深夜では、燃料電池の発電単価の方が高くなり、燃料電池を停止し外部電源から電力を買った方が経済的である。さらに、特開平6-325774号広報の技術に関しては、電力負荷の電力消費によっては電気料金の単価の高い昼間時間帯に入る直前に蓄電量がなくなり、消費電力量の多い昼間時間帯に高い電気を買う必要が生じる場合があり、電気料金と燃料ガス料金の合計が高くなるという問題があった。

【0009】本発明は、上述した従来の燃料電池システムの制御装置の課題を考慮し、1日において電力料金体系が時間帯ごとに変化しても、料金体系を反映させた燃料電池の運転方法をスケジュールすることにより、電気料金と燃料ガス料金の合計をできるだけ小さくできる手段を提供するものである。

【0010】

【課題を解決するための手段】上記課題を解決するために、本発明の燃料電池の制御装置は、燃料ガスと空気とから電力と熱を発生させ、それぞれを電力負荷と熱負荷

とに供給する燃料電池システムにおいて、燃料電池の発電出力を蓄積する蓄電池と、1日の運転スケジュールを定める運転スケジュール作成部と、前記燃料電池の発電出力および前記蓄電池における充電または放電を、前記運転スケジュールに従って制御する制御部とを備え、前記運転スケジュール作成部は、1日の時間帯を3つの時間帯、すなわち、電気料金の単価が燃料電池の発電単価よりも高い高電気料金時間帯、電気料金の単価が燃料電池の発電単価と同じである等価時間帯、および電気料金の単価が燃料電池の発電単価よりも低い低電気料金時間帯に分割し、前記高電気料金時間帯では、燃料電池は前記電力負荷が消費する量の電力を発電し、前記等価時間帯では、燃料電池は消費されなかった電力を前記蓄電池に充電し、低電気料金時間帯では、燃料電池を停止もしくは第一の運転能力で運転するように、運転スケジュールを作成する構成とした。

【0011】

【発明の実施の形態】（第1の実施の形態）図1は本発明の第1の実施の形態における制御装置の構成を示す構成図である。1は燃料電池、2は燃料電池が出力する直流電力を交流電力に変換するインバータ、3は電力負荷20の消費電力を測定する消費電力量測定部である。消費電力量測定部3は電力センサであり、インバータ2に内蔵されていてもよい。4は直流電力を充電する蓄電池であり、蓄電量を制御装置に出力することができる。30 50は外部電源50より電気を買う場合に必要なスイッチである。外部電源50は電力会社等、商用電力を供給販売する事業者のことである。また、31、32は蓄電池4の充放電を行うために必要なスイッチである。なお、21は燃料電池1が出力する熱を利用する熱負荷である。

【0012】10は制御装置で、制御部11、運転スケジュール作成部12、発電量単価算出部13、電気料金体系記憶部14、燃料ガス料金体系記憶部15、タイム19で構成される。

【0013】電気料金体系記憶部14および燃料ガス料金体系記憶部15は、それぞれ、1日の時間帯ごとの電気料金の単価および燃料ガス料金の単価を記憶している。発電量単価算出部13は、燃料電池1の運転能力を選ぶと燃料ガス入力エネルギーと、発電効率と温水効率とで表す燃料電池1のエネルギー効率とを得る性能テーブルを保持しており、燃料電池1が単位電力量を発電するのに必要なコストとして、燃料電池の発電単価を算出する。

【0014】運転スケジュール作成部12は、発電量単価算出部13から燃料電池の発電単価を取得し、電気料金体系記憶部14から得る電気料金の単価と比較し、その大小により燃料電池1の運転スケジュールを決める。制御部11は運転スケジュール作成部12が決めた運転スケジュールに従い燃料電池1を運転し、タイム19か

ら現在時間を取り燃料電池1の発電出力制御やスイッチ30、31、32を操作する。

【0015】次に、このような本実施の形態の動作について説明する。

【0016】1日に1度、制御部11は燃料電池1の運転スケジュールを決める。スケジュールの決定は、電力負荷20の変化があまりなく、電気料金の単価の変化がない深夜が良い。まず、発電量単価算出部13において、燃料電池1の発電単価の計算を行う。燃料ガス料金体系記憶部15から燃料ガス料金体系を取得し、燃料ガスの単価と燃料電池のエネルギー効率とから発電単価を試算する。現在は、燃料ガスの単価は1日の時間帯によって変化することではなく、燃料電池1の運転スケジュールを決める時に使う燃料ガスの単価は唯一である。

【0017】エネルギー効率としては、例えば燃料電池1を定格の1/2で運転させた場合の値を用いる。さらに燃料電池システム全体の償却を考えるならば、燃料電池システムの価格を、想定する償却期間と1日あたりの想定発電量とで除して求まる単位発電量あたりの燃料電池システム価格を、先程求めた発電単価に組み入れても良い。燃料電池システムの定格運転時における発電効率を30%、温水効率を40%、価格を50万円、15年償却で1日15kWh発電したと仮定すると、発電単価は20~24円/kWhとなる。発電量単価算出部13は燃料電池1の発電単価を運転スケジュール作成部12に出力する。

【0018】運転スケジュール作成部12は、発電量単価算出部13から燃料電池の発電単価を取得し、燃料電池1の発電単価と外部電源50より電気を買った場合の電気料金の単価とを比較し燃料電池1の運転スケジュールを決める。電気料金体系記憶部14から1日の電気料金の単価を取得し、電気料金の単価が異なる時間を境に1日を複数の時間帯に分ける。これらの時間帯ごとに燃料電池の発電単価と電気料金の単価とを比較する。

【0019】電気料金の単価が燃料電池1の発電単価より低い低電気料金時間帯では燃料電池1を停止もしくは第一の運転能力で運転するようにスケジュールを組む。低電気料金時間帯が短い場合には、次の時間帯の燃料電池の運転方式にスムーズに移行するため燃料電池1を第一の運転能力で運転持続するのが望ましい。逆に電気料金の単価が燃料電池1の発電単価より同等もしくは高い時間帯は、燃料電池1を運転するようにスケジュールリングする。

【0020】ただし、電気料金の単価が燃料電池1の発電単価よりも高い高電気料金時間帯には、外部電源50より買電を行わないフラグを立てる。さらに、この時間帯では極力買電を行わないために電力負荷20の消費電力に追従する運転を行うようにスケジュールリングする。一方、電力料金の単価が燃料電池の発電単価と同等の等価時間帯は買電を可とするフラグを立てておく。

【0021】なお、実際の燃料電池の発電単価は燃料電池1の運転効率によって変化し、また運転効率の時系列的な予測を行うのは困難なため、1日を複数の時間帯に分ける時には、発電量単価算出部13で算出した発電単価にある程度の幅を持たせ、電気料金の単価がこの幅の中に入っているか否かで決定するのが望ましい。例えば1.5kW級の燃料電池の場合、燃料電池を定格の1/2で運転させた場合を基準とすると、定格で運転させた場合の発電単価は1割程度向上し、定格の1/4で運転させた場合の発電単価は1割程度低下する。

【0022】従って、運転スケジュール作成部12は、発電単価に幅を持たせるための上限定数として例えば1.1、下限定数として例えば0.9を保持しており、発電量単価算出部13が算出した燃料電池が定格の1/2で運転した場合の発電単価を受け、電気料金の単価が発電単価に上限定数をかけた値よりも高い時間帯を高電気料金時間帯、電気料金の単価が発電単価に上限定数をかけた値以下でかつ発電単価に下限定数をかけた値よりも高い時間帯を等価時間帯、そして電気料金の単価が発電単価に下限定数をかけた値以下の時間帯を低電気料金時間帯と定めるのが現実的である。現在、東京電力(株)管内の全電化住宅では、低電気料金時間帯は23時から翌日朝7時、等価時間帯は7時から10時、および17時から23時、高電気料金時間帯は10時から17時の時間帯にそれぞれ該当する。

【0023】次に運転スケジュール作成部12は、等価時間帯において蓄電池4に充電するスケジュールを決定する。高電気料金時間帯では、夏場のエアコン運転などで電力負荷20の消費電力は大きくなり、燃料電池1を定格運転した場合の最大発電出力を越える場合が多い。従って高電気料金時間帯に入る前に蓄電池4に十分な電力量を充電しておく。蓄電池4への充電は、等価時間帯に行う。高電気料金時間帯と時間的な隔りがある低価格時間帯に充電を行うと蓄電量が自然放電してしまうため、結果的に充電効率が悪くなるからである。

【0024】蓄電池4を充電しておくことにより、高電気料金時間帯において電力負荷20の消費電力が燃料電池1の最大発電出力を越えても、蓄電池4を放電すれば電力負荷の増加に対処でき高価な電気を買わずに済む。また、高電気料金時間帯において電力負荷20の消費電力が急激に増加した場合に、蓄電池4を放電すれば電力負荷追従運転する際の燃料電池1の時間応答の悪さから生じる発電出力不足を埋め合わせて買電量を無くすことができる。

【0025】等価時間帯で蓄電池4を充電する方法として、例えば、等価時間帯の当初で、蓄電池4が満充電になるまで燃料電池1を効率の良い定格運転させるようにスケジュールリングする。なお、等価時間帯では、蓄電池4が満充電できるのであればどのようなスケジュールを立てても良いが、燃料電池自体の時間応答性の悪さや外

部電源50から買電してもよい時間帯であることを考慮すると、定格運転や発電量一定運転、もしくはこれらを組み合わせて運転するのが望ましい。

【0026】運転スケジュール作成部12は、以上により求めた燃料電池1のスケジュールを制御部11に渡す。制御部11はスケジュールに従って燃料電池1を運転する。等価時間帯では、まず燃料電池1を定格運転し、スイッチ31を動作して余った発電出力を蓄電池4に充電する。この時間帯では、電力負荷20の消費電力が定格を越えた場合や消費電力の変化に追従しきれない場合は、スイッチ30を動作させ外部電源50より買電を行い対処する。高電気料金時間帯になると、定格発電量を越えるような電力消費が発生した場合には、スイッチ32を動作して蓄電池の充電量を電力負荷20に供給するようにスイッチを制御する。また、低電気料金時間帯では、燃料電池を停止させ、電力負荷が必要な電力量を全て外部から購入するか、燃料電池を最低の運転能力（本明細書中では第一の運転能力と記載する）で運転する。最低の運転能力とは、現在の燃料電池において、定格の約1/4で運転することである。

【0027】以上より、本実施の形態の構成にすることで、外部電源50から買電する場合の電気料金の単価と燃料電池1の発電単価とを比較し、その大小に応じて1日を3つの時間帯に区分して、低電気料金時間帯には燃料電池を停止または第一の運転能力で運転し、等価時間帯には燃料電池の発電出力を蓄電池に充電し、高電気料金時間帯には外部電源から買電を行わずに蓄電池の充電量を使用しながら電力負荷追従運転を行うように燃料電池の運転スケジュールを決定するので、電気料金と燃料ガス料金の合計を小さくする燃料電池システムの制御装置を提供することができる。

【0028】（第2の実施の形態）図2は本発明の第2の実施の形態における制御装置の構成を示す構成図である。16は消費電力計測部3で計測した電力負荷20の消費電力の時系列データを、前日もしくは前日より所定期間分格納する消費電力量保存部である。この所定期間は1週間程度が望ましい。その他の構成は第1の実施の形態と同様なので説明は省略する。

【0029】次に、このような本実施の形態の動作について説明する。

【0030】運転スケジュール作成部12は、等価時間帯において蓄電池4に充電するスケジュールを決める段階において、消費電力量保存部16から前日もしくは前日から過去の所定期間における電力負荷20の消費電力の時系列データを取得する。複数日の時系列データを取得した場合は平均化処理を行う。次に過去のデータから、高電気料金時間帯で電力負荷20の消費電力が燃料電池1の最大発電出力を越えた時間を調べ、消費電力の最大発電出力からの超過分に超過時間幅を掛け値を積算して超過消費電力量を計算する。この消費電力量は外

部電源50から買電する可能性がある電力量に相当する。

【0031】買電可のフラグが立っている等価時間帯では、この超過消費電力量を蓄電池4に充電するようにスケジュールリングする。これにより充電量の無駄を極力減らすことが可能となる。充電時の燃料電池1の運転方法としては、例えば等価時間帯の当初で蓄電池4に超過消費電力量と等しい電力量が充電するまで燃料電池1を効率の良い定格運転させる手法が挙げられる。

【0032】制御部11は、運転スケジュール作成部12より得る燃料電池1の運転スケジュールに従って燃料電池1を運転する。なお、制御部11が消費電力計測部3より得る電力負荷20の消費電力量は消費電力量保存部16に保存する。

【0033】以上により、本実施の形態の構成にすることで、等価時間帯における蓄電池4の充電量の無駄を省き、かつ第1の実施の形態と同じ効果を得ることができる。

【0034】（第3の実施の形態）図3は本発明の第3の実施の形態における制御装置の構成を示す構成図である。25は外部電源50が送信する電気料金体系情報を受信する通信部である。通信部25は例えばターミナルアダプタで、外部電源50とは例えばデジタル専用線や公衆回線で接続し、制御装置10とは共通のインターフェイスで接続している。電気料金体系情報は、時間帯ごとの電気料金の単価が格納されている。その他の構成は第1の実施の形態と同様なので説明は省略する。

【0035】次に、このような本実施の形態の動作について説明する。

【0036】外部電源50が電気料金体系情報を送信した場合、通信部25は該情報を受け取り制御部10内の電気料金体系記憶部14に格納する。運転スケジュール作成部12は電気料金体系記憶部14の内容が変化した時、これをトリガにして新しい電気料金体系に従った燃料電池1の運転スケジュールを決定し直す。例えば夏の昼間などで外部電源50の電力供給が逼迫すると予測した場合などに、外部電源50は通信部25に昼間の電気料金の単価を高く設定したり電気料金の単価が高い時間帯幅を拡張するなどの変更を施した電気料金体系を送信する。すると、運転スケジュール作成部12は、新たな電気料金体系のに基づき、買電を行わないというフラグを立てる時間帯を変更したり、蓄電池4に蓄電する時間の変更および蓄電量の変更を行う。

【0037】以上により、本実施の形態の構成にすることで、外部電源50が電気料金の単価の変更を行った場合に、高い即時性で燃料電池の運転スケジュールを変更できる。

【0038】

【発明の効果】以上説明したところから明らかなよう

に、本発明は、電力供給に燃料電池と外部電源を併用し

た場合に、外部電源から買電する場合の電気料金の単価と燃料電池の発電単価とを比較し、その大小に応じて1日を3つの時間帯に区分して、低電気料金時間帯には燃料電池を停止し、等価時間帯には燃料電池の発電出力を蓄電池に充電し、高電気料金時間帯には外部電源から買電を行わずに蓄電池の充電量を使用しながら電力負荷追従運転を行うように燃料電池の運転スケジュールを決定するので、電気料金と燃料ガス料金の合計を小さくする燃料電池システムの制御装置を提供することができる。

【0039】さらに、外部電源との通信部を設けることにより、外部電源が電気料金の単価の変更した場合に高い即時性で燃料電池の運転スケジュールを変更することが可能となる。

【図面の簡単な説明】

【図1】本発明の実施の形態1における制御装置の構成を示す構成図

【図2】本発明の実施の形態2における制御装置の構成を示す構成図

【図3】本発明の実施の形態3における制御装置の構成を示す構成図

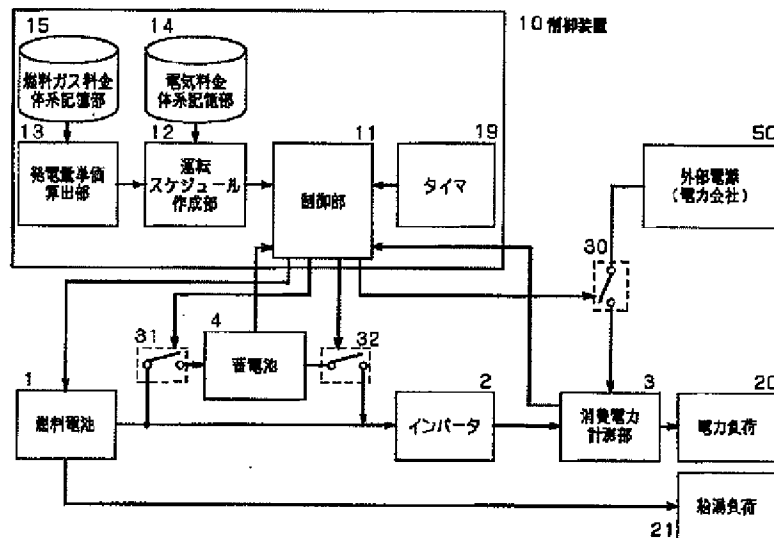
【図4】特開平6-325774号広報に記載された技*

* 術の構成図

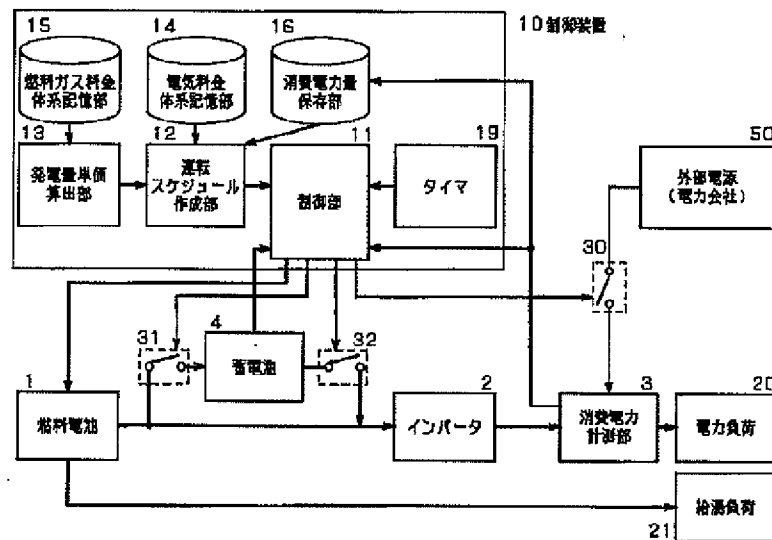
【符号の説明】

- | | |
|----|-------------|
| 1 | 燃料電池 |
| 2 | インバータ |
| 3 | 消費電力計測部 |
| 4 | 蓄電池 |
| 10 | 制御装置 |
| 11 | 制御部 |
| 12 | 運転スケジュール作成部 |
| 13 | 発電量単価算出部 |
| 14 | 電気料金体系記憶部 |
| 15 | 燃料ガス料金体系記憶部 |
| 16 | 消費電力量保存部 |
| 19 | タイマ |
| 20 | 電力負荷 |
| 21 | 給湯負荷 |
| 25 | 通信部 |
| 30 | スイッチ |
| 31 | スイッチ |
| 32 | スイッチ |
| 50 | 外部電源 |

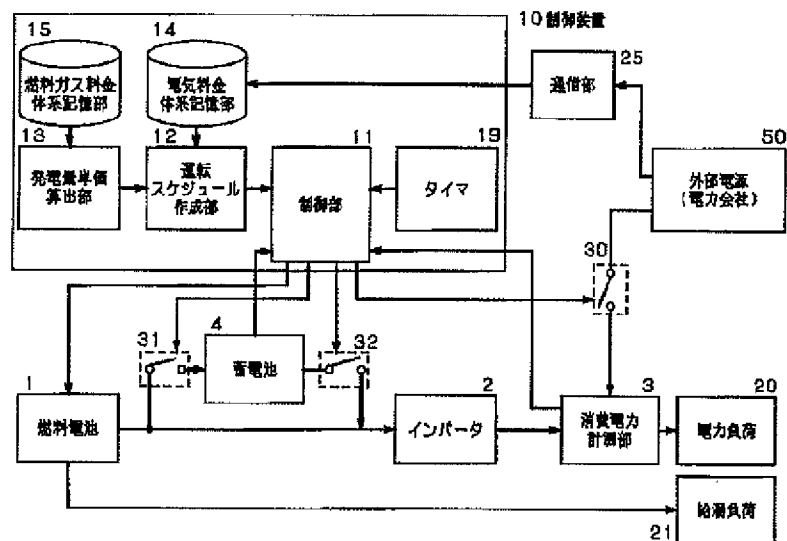
【図1】



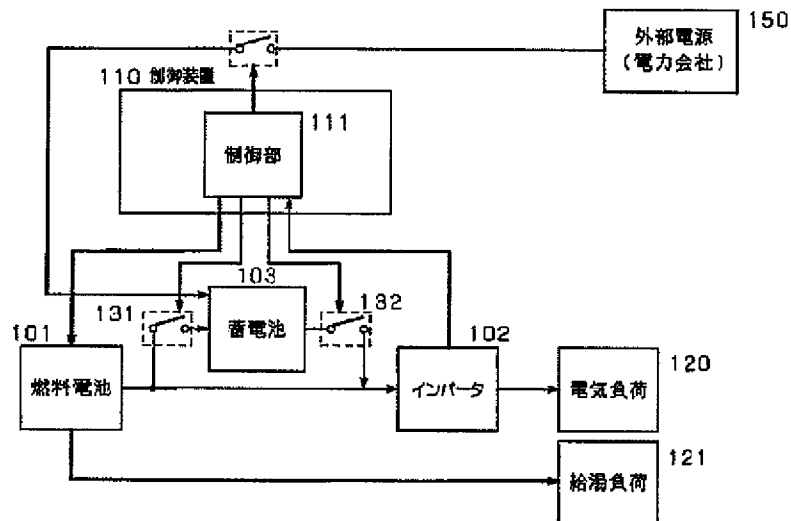
【図2】



【図3】



【図4】



フロントページの続き

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JA07 JA12 JB03 KA12

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(22)Date of filing : 27.12.2000

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(54) CONTROL DEVICE OF FUEL CELL SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To avoid such a situation in which the sum of the costs for electricity and fuel gas is higher than in the case of fuel cell operation.

SOLUTION: An operation schedule making part 12 divides a day into a plurality of time slots according to difference of unit price of electricity fee, at each of which, a unit price of electricity is compared with a power-generating unit price for a fuel cell calculated at a power-generating unit price calculating part 13, where, the operation schedule of the fuel cell 1 is made so that a storage cell 4 is charged at time zones when the unit price of electricity is equivalent to power generating unit price.

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CLAIMS

[Claim(s)]

[Claim 1]Have the following and said driving schedule preparing part, A time zone on the 1st Three time zones, i.e., a high electricity bill time zone when a unit price of an electricity bill is higher than a power generation unit price of a fuel cell, Rather than a power generation unit price of a fuel cell, the equivalent time belt as a power generation unit price of a fuel cell with same unit price of an electricity bill and a unit price of an electricity bill divide in a low low electricity bill time zone, and in said high electricity bill time zone. A fuel cell generates electric power of quantity which said power load consumes, and in said equivalent time belt. A fuel cell charges said storage battery and electric power which was not consumed in a low electricity bill time zone. A fuel cell system which generates electric power and heat from fuel gas and air which are characterized by creating a driving schedule so that a fuel cell may be operated by a stop or the first driving ability, and supplies each to power load and heat load.

A storage battery which accumulates a generation output of a fuel cell.

A driving schedule preparing part which defines a driving schedule on the 1st.

A control section which controls charge or discharge in a generation output and said storage battery of said fuel cell according to said driving schedule.

[Claim 2]Have the following and said driving schedule preparing part, A time zone on the 1st Three time zones, i.e., a high electricity bill time zone when a unit price of an electricity bill is higher than a power generation unit price of a fuel cell, Rather than a power generation unit price of a fuel cell, the equivalent time belt as a power generation unit price of a fuel cell with same unit price of an electricity bill and a unit price of an electricity bill divide in a low low electricity bill time zone, and in said high electricity bill time zone. Although said fuel cell generates electric power of quantity which said power load consumes and said fuel cell charges said storage battery in said equivalent time belt, From amount of used electricity used in a subsequent high electricity bill time zone, electric energy charged here is the maximum production of electricity of a fuel cell the subtracted electric energy, and here, Charge starting time is set as using it from immediately after a charge end, and charged electric energy in a low electricity bill time zone. A fuel cell system which generates electric power and heat from fuel gas and air which are characterized by creating a driving schedule so that said fuel cell may be operated by a stop or the first driving ability, and supplies each to power load and heat load.

A storage battery which accumulates a generation output of a fuel cell.

An amount-of-used-electricity preserving part which saves information about change of electric energy which said power load consumes.

A driving schedule preparing part which defines a driving schedule on the 1st.

A control section which controls charge or discharge in a generation output and said storage battery of said fuel cell according to said driving schedule.

[Claim 3]Have the communications department which receives electricity bill system information from an external power, and said driving schedule preparing part, A control device of the fuel cell control system according to claim 1 or 2 creating a driving schedule of said fuel cell when said

electricity bill storage parts store acquires information on said electricity bill system.

[Claim 4] Rather than a value which multiplied a power generation unit price of said fuel cell by an upper limit constant in said high electricity bill time zone, a unit price of said electricity bill is high, and in said equivalent time belt. Rather than a value which multiplied below a value that multiplied a power generation unit price of said fuel cell by an upper limit constant, and a power generation unit price of said fuel cell by a lower limit constant, it is high and in said low electricity bill time zone. A control device of the fuel cell system according to any one of claims 1 to 3 being below a value which multiplied a power generation unit price of said fuel cell by a lower limit constant.

[Claim 5] A control device of the fuel cell system according to any one of claims 1 to 3 charging a part of electric energy where operates only a period with an equivalent time belt in rating, and said power load uses said fuel cell in a high electricity bill time zone behind said equivalent time belt.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to a power generation system which used the fuel cell, and an operating method for the same.

[0002]

[Description of the Prior Art]A fuel cell is an energy saving system which also supplies the heat generated in process of power generation at the same time it generates it by the chemical reaction of fuel gas and air and it performs an electric power supply. The operating method of a fuel cell has the common technique of carrying out a purchased power from commercial power, when power load flattery operation which unites the production of electricity of a fuel cell with the amount of used electricity of power load is performed and amount of used electricity exceeds the amount of rated power generation of a fuel cell conventionally.

[0003]However, if the cost of the fuel gas taken for the power generation unit price by a fuel cell, i.e., a fuel cell, to generate unit electric energy does not have ** lower than the purchased-power cost in the case of buying commercial power from an electric power company etc., there will be no economical merit which makes a fuel cell system operate. The unit price of the electricity bill in the all-electric home in a present Co., Inc., for example, the Tokyo Electric Power, pipe is classified into the three-stage by the time zone per day.

The fee gap with a time zone will be 5 or more times in summer the midnight time zone when the unit price of an electricity bill is the cheapest, and the highest daytime.

On the other hand, if the cost of fuel gas and the generation efficiency of a fuel cell are taken into consideration, the power generation unit price of a fuel cell will become a value between the unit prices of a time zone the unit price of the electricity bill of midnight time zone, and daytime. Therefore, even if it operates a fuel cell in the time zone when the unit price of electricity bills, such as midnight, is cheap, there is no economical merit.

[0004]It is difficult for the actual condition to make the production of electricity of a fuel cell follow power load. It is because the time lag of an order arises several minutes to control the amount of supply of fuel gas and complete the production of electricity of a fuel cell as a target control value. A storage battery is prepared, as art of coping with such a problem, when amount of used electricity decreases, it stores electricity and amount of used electricity increases, it discharges, and even if the amount of used electricity of power load changes, there are some which hold the production of electricity of a fuel cell uniformly as much as possible. There is art of JP,6-325774,A public relations as an example.

[0005]The lineblock diagram of the art indicated to JP,6-325774,A public relations is shown in drawing 6. The inverter which changes into alternating current power the direct current power whose 101 is a fuel cell, and whose 102 is an output of a fuel cell, and 103 are storage batteries which charge direct current power. 110 is a control device and has the control section 111. It is a switch which power load, water-heating load, and 131, 132 and 133 receive instructions from 120, receives 121 from the control section 111, respectively, and operates. 150 is an external power and an electric power company deserves it.

[0006]The operation is explained below. The fuel cell 101 is operating production-of-electricity

regularity, and if the amount of used electricity of the power load 120 decreases, it will charge the electric power which connected the switch 131 and remained at the storage battery 103. Conversely, if the amount of used electricity of the power load 120 increases, the switch 132 will be connected, the storage battery 103 will be discharged, and the power load 120 will be supplied. When the amount of accumulation of electricity of the storage battery 103 fills, or when the amount of accumulation of electricity is drained, the control section 111 outputs a control signal so that the production of electricity of a fuel cell may decrease or increase.

[0007]The control section 111 issues the instructions which connect the switch 133, purchases relatively cheap night power from the external power 150, and charges the storage battery 103.

[0008]

[Problem(s) to be Solved by the Invention]However, in the control device of a fuel cell system mentioned above, there was a problem that comparison with the power generation unit price of a fuel cell and the purchased-power cost which changes in a time zone based on electricity bill systems, such as an electric power company, is not made, but the direction at the time of making a fuel cell operate may become high in the unit price of an electricity bill. For example, it is more economical for the direction of the power generation unit price of a fuel cell to have become high, to have stopped the fuel cell, and to buy electric power with the midnight when the unit price of an electricity bill is cheap from an external power. About the art of JP,6-325774,A public relations, Just before entering in a time zone the daytime when the unit price of an electricity bill is high depending on the power consumption of power load, the amount of accumulation of electricity was lost, and he may need to buy the high electrical and electric equipment with much amount of used electricity in a time zone daytime, and there was a problem that the sum total of an electricity bill and a fuel gas fee became high.

[0009]Even if electric rate structure changes for every time zone in one day in consideration of the technical problem of the control device of the conventional fuel cell system mentioned above, this invention, By scheduling the operating method of the fuel cell in which the tariff structure was made to reflect, the means which can make the sum total of an electricity bill and a fuel gas fee as small as possible is provided.

[0010]

[Means for Solving the Problem]In order to solve an aforementioned problem, a control device of a fuel cell of this invention, In a fuel cell system which generates electric power and heat from fuel gas and air, and supplies each to power load and heat load, A storage battery which accumulates a generation output of a fuel cell, and a driving schedule preparing part which defines a driving schedule on the 1st, Have a control section which controls charge or discharge in a generation output and said storage battery of said fuel cell according to said driving schedule, and said driving schedule preparing part, A time zone on the 1st Three time zones, i.e., a high electricity bill time zone when a unit price of an electricity bill is higher than a power generation unit price of a fuel cell, Rather than a power generation unit price of a fuel cell, the equivalent time belt as a power generation unit price of a fuel cell with same unit price of an electricity bill and a unit price of an electricity bill divide in a low low electricity bill time zone, and in said high electricity bill time zone. A fuel cell generated electric power of quantity which said power load consumes, and with said equivalent time belt, a fuel cell charged electric power which was not consumed at said storage battery, and in a low electricity bill time zone, it was considered as composition which creates a driving schedule so that a fuel cell might be operated by a stop or the first driving ability.

[0011]

[Embodiment of the Invention](A 1st embodiment) Drawing 1 is a lineblock diagram showing the composition of the control device in a 1st embodiment of this invention. The inverter which changes into alternating current power the direct current power with which a fuel cell outputs 1 and a fuel cell outputs 2, and 3 are amount-of-used-electricity test sections which measure the power consumption of the power load 20. The amount-of-used-electricity test section 3 is a power sensor, and may be built in the inverter 2. 4 is a storage battery which charges direct current power, and can output the amount of accumulation of electricity to a control device. 30 is a required switch when you buy the electrical and electric equipment from the external power

50. The external powers 50 are business units which do supply sale of the commercial power, such as an electric power company. 31 and 32 are switches required in order to perform the charge and discharge of the storage battery 4. 21 is the heat load using the heat which the fuel cell 1 outputs.

[0012]10 is a control device and comprises the control section 11, the driving schedule preparing part 12, the production-of-electricity unit price calculation part 13, the electricity bill system storage parts store 14, the fuel gas tariff structure storage parts store 15, and the timer 19.

[0013]The electricity bill system storage parts store 14 and the fuel gas tariff structure storage parts store 15 have memorized the unit price of the electricity bill for every time zone on the 1st, and the unit price of a fuel gas fee, respectively. When the driving ability of the fuel cell 1 is chosen, the production-of-electricity unit price calculation part 13 Fuel gas input energy, The performance table which obtains the energy efficiency of the fuel cell 1 expressed with generation efficiency and warm water efficiency is held, and the power generation unit price of a fuel cell is computed as cost required for the fuel cell 1 to generate unit electric energy.

[0014]The driving schedule preparing part 12 acquires the power generation unit price of a fuel cell from the production-of-electricity unit price calculation part 13, and determines the driving schedule of the fuel cell 1 by the size as compared with the unit price of the electricity bill obtained from the electricity bill system storage parts store 14. The control section 11 operates the fuel cell 1 according to the driving schedule which the driving schedule preparing part 12 determined, takes current time from the timer 19, and operates generation output control and the switches 30, 31, and 32 of the fuel cell 1.

[0015]Next, operation of such this embodiment is explained.

[0016]The control section 11 determines the driving schedule of the fuel cell 1 once on the 1st. The determination of a schedule has the good midnight which does not not much have change of the power load 20, and does not have change of the unit price of an electricity bill. First, in the production-of-electricity unit price calculation part 13, the power generation unit price of the fuel cell 1 is calculated. The fuel gas tariff structure is acquired from the fuel gas tariff structure storage parts store 15, and the trial calculation of a power generation unit price is made from the unit price of fuel gas, and the energy efficiency of a fuel cell. The unit price of the fuel gas used when the unit price of fuel gas does not change depending on the time zone on the 1st and the driving schedule of the fuel cell 1 is decided now is only.

[0017]As energy efficiency, the value at the time of for example making the fuel cell 1 operate by one half of rating is used. If refund of the whole fuel cell system is furthermore considered, the fuel cell system price per unit production of electricity which can be *(ed) and found in the depreciation period and the assumption production of electricity per day supposing the price of fuel cell systems may be included in the power generation unit price for which it asked previously. If the generation efficiency at the time of the rated operation of a fuel cell system is assumed to have generated warm water efficiency and to have generated 15 kWh per of prices day by refund 40% 30% for 500,000 yen and 15 years, a power generation unit price will be set to kWh in 20 to 24 yen /. The power generation unit price calculation part 13 outputs the power generation unit price of the fuel cell 1 to the driving schedule preparing part 12.

[0018]The driving schedule preparing part 12 acquires the power generation unit price of a fuel cell from the production-of-electricity unit price calculation part 13, compares the unit price of the electricity bill at the time of buying the electrical and electric equipment from the power generation unit price and the external power 50 of the fuel cell 1, and determines the driving schedule of the fuel cell 1. The unit price of the electricity bill on the 1st is acquired from the electricity bill system storage parts store 14, and one day is divided into two or more time zones bordering on the time when the unit prices of an electricity bill differ. The power generation unit price of a fuel cell is compared with the unit price of an electricity bill for every time zones of these.

[0019]In the low electricity bill time zone when the unit price of an electricity bill is lower than the power generation unit price of the fuel cell 1, a schedule is constructed so that the fuel cell 1 may be operated by a stop or the first driving ability. When a low electricity bill time zone is short, since it shifts to the operating method of the fuel cell of the next time zone smoothly, it is

desirable to carry out operation continuation of the fuel cell 1 by the first driving ability. Conversely, scheduling of the time zone when the unit price of an electricity bill is equivalent or higher than the power generation unit price of the fuel cell 1 is carried out so that the fuel cell 1 may be operated.

[0020]However, in the high electricity bill time zone when the unit price of an electricity bill is higher than the power generation unit price of the fuel cell 1, the flag which does not perform a purchased power from the external power 50 is set. In this time zone, in order not to perform a purchased power as much as possible, scheduling is carried out so that operation which follows the power consumption of the power load 20 may be performed. On the other hand, the equivalent time belt with a unit price of power rates equivalent to the power generation unit price of a fuel cell sets the flag which makes a purchased power good.

[0021]Since it is difficult for the power generation unit price of a actual fuel cell to change with the operating efficiency of the fuel cell 1, and to perform serial prediction of operating efficiency, when dividing one day into two or more time zones, It is desirable to determine whether gave a certain amount of width to the power generation unit price computed by the production-of-electricity unit price calculation part 13, and the unit price of the electricity bill is contained in this width. For example, if based on the case where a fuel cell is made to operate by one half of rating in the case of 1.5-kW class of a fuel cell, the power generation unit price at the time of making it operate in rating will improve about ten percent, and the power generation unit price at the time of making it operate by one fourth of rating will fall about ten percent.

[0022]Therefore, the driving schedule preparing part 12 holds 1.1 as an upper limit constant for giving width to a power generation unit price, and holds 0.9 as a lower limit constant. A power generation unit price when the fuel cell which the production-of-electricity unit price calculation part 13 computed operates by one half of rating is received, The unit price of an electricity bill a high time zone rather than the value which multiplied the power generation unit price by the upper limit constant A high electricity bill time zone, It is realistic to set the time zone below the value with which the equivalent time belt and the unit price of the electricity bill multiplied the power generation unit price for the time zone higher than the value which is below the value with which the unit price of the electricity bill multiplied the power generation unit price by the upper limit constant, and multiplied the power generation unit price by the lower limit constant by the lower limit constant as a low electricity bill time zone. Now, as for a low electricity bill time zone, from 23:00, a high electricity bill time zone corresponds to the time zone at 7:00 from 7:00 at 10:00 and 17:00 to 23:00, and an equivalent time belt corresponds to the time zone at 10:00 to 17:00 in the morning on the next day, respectively in the all-electric home in the Tokyo Electric Power Co., Inc. pipe.

[0023]Next, the driving schedule preparing part 12 determines the schedule which charges the storage battery 4 in an equivalent time belt. In a high electricity bill time zone, the power consumption of the power load 20 becomes large by air-conditioner operation of summer, etc., and the maximum generation output at the time of carrying out rated operation of the fuel cell 1 is exceeded in many cases. Therefore, before entering in a high electricity bill time zone, sufficient electric energy for the storage battery 4 is charged. Charge to the storage battery 4 is performed on an equivalent time belt. It is because the amount of accumulation of electricity discharges automatically, so charging efficiency will worsen as a result if a high electricity bill time zone and a low-price time zone with time distance are charged.

[0024]Even if the power consumption of the power load 20 exceeds the maximum generation output of the fuel cell 1 in a high electricity bill time zone by charging the storage battery 4, if the storage battery 4 is discharged, he can cope with the increase in power load, and does not need to buy the expensive electrical and electric equipment. When the power consumption of the power load 20 increases rapidly in a high electricity bill time zone, if the storage battery 4 is discharged, it can compensate for the shortage of a generation output produced from the badness of the time response of the fuel cell 1 at the time of carrying out power load flattery operation, and the amount of purchased powers can be lost.

[0025]As a method of charging the storage battery 4 with an equivalent time belt, in the beginning of an equivalent time belt, scheduling is carried out, for example so that rated

operation of the fuel cell 1 may be carried out that it is easy to be efficiency, until the storage battery 4 becomes a full charge. If what kind of schedule may be stood in an equivalent time belt as long as it can carry out the full charge of the storage battery 4, but it takes into consideration that it is a time zone which may carry out a purchased power from the badness and the external power 50 of time response nature of the fuel cell itself, It is desirable to operate combining rated operation, production-of-electricity fixed operation, or these.

[0026]The driving schedule preparing part 12 passes the schedule of the fuel cell 1 which was able to be found by the above to the control section 11. The control section 11 operates the fuel cell 1 according to a schedule. In an equivalent time belt, rated operation of the fuel cell 1 is carried out first, and the generation output which operated and remained the switch 31 is charged at the storage battery 4. In this time zone, when change of the case where the power consumption of the power load 20 exceeds rating, or power consumption cannot be followed, the switch 30 is operated, and from the external power 50, a purchased power is performed and it is coped with. When a high electricity bill time zone came and power consumption which exceeds the amount of rated power generation occurs, a switch is controlled to operate the switch 32 and to supply the charge of a storage battery to the power load 20. In a low electricity bill time zone, a fuel cell is stopped, and all the electric energy that needs power load is purchased from the outside, or a fuel cell is operated according to the minimum driving ability (this detailed hottest season indicates the first driving ability). The minimum driving ability is a thing of rating which about 1/operates by 4 in the present fuel cell.

[0027]As mentioned above, by having composition of this embodiment, compare the unit price of the electricity bill in the case of carrying out a purchased power from the external power 50 with the power generation unit price of the fuel cell 1, and one day is classified into three time zones according to the size, In a low electricity bill time zone, a fuel cell is operated by a stop or the first driving ability, Since it determines that the driving schedule of a fuel cell will perform power load flattery operation, charging a storage battery for the generation output of a fuel cell at an equivalent time belt, and using the charge of a storage battery for a high electricity bill time zone without performing a purchased power from an external power, The control device of the fuel cell system which makes small the sum total of an electricity bill and a fuel gas fee can be provided.

[0028](A 2nd embodiment) Drawing 2 is a lineblock diagram showing the composition of the control device in a 2nd embodiment of this invention. 16 is an amount-of-used-electricity preserving part which stores the time series data of the power consumption of the power load 20 measured by the power consumption measuring part 3 by a prescribed period from the previous day on the previous day. As for this prescribed period, about one week is desirable. Since other composition is the same as that of a 1st embodiment, explanation is omitted.

[0029]Next, operation of such this embodiment is explained.

[0030]In the stage of deciding the schedule which charges the storage battery 4 in an equivalent time belt, the driving schedule preparing part 12 acquires the time series data of the power consumption of the power load 20 in the prescribed period of the previous day on the previous day to the past from the amount-of-used-electricity preserving part 16. Equalizing processing is performed when the time series data on two or more are acquired. Next, from the past data, excess amount of used electricity is calculated by investigating the time when the power consumption of the power load 20 exceeded the maximum generation output of the fuel cell 1 in the high electricity bill time zone, and integrating the value which applied excess time width to an exceeded part from the maximum generation output of power consumption. This amount of used electricity is equivalent to the electric energy which may carry out a purchased power from the external power 50.

[0031]In the equivalent time belt with which the flag with a good purchased power stands, scheduling is carried out so that this excess amount of used electricity may be charged at the storage battery 4. It enables this to reduce the futility of a charge as much as possible. As an operating method of the fuel cell 1 at the time of charge, the efficient technique of carrying out rated operation is mentioned in the fuel cell 1 until electric energy equal to excess amount of used electricity charges the storage battery 4, for example in the beginning of an equivalent time belt.

[0032]The control section 11 operates the fuel cell 1 according to the driving schedule of the fuel cell 1 obtained from the driving schedule preparing part 12. The control section 11 saves the amount of used electricity of the power load 20 obtained from the power consumption measuring part 3 at the amount-of-used-electricity preserving part 16.

[0033]By the above, by having composition of this embodiment, the futility of the charge of the storage battery 4 in an equivalent time belt can be excluded, and the same effect as a 1st embodiment can be acquired.

[0034](A 3rd embodiment) Drawing 3 is a lineblock diagram showing the composition of the control device in a 3rd embodiment of this invention. 25 is the communications department which receives the electricity bill system information which the external power 50 transmits. The communications department 25 is a terminal adopter, in the external power 50, connected with the digital leased line or the public line, and has connected with an interface with the common control device 10. As for electricity bill system information, the unit price of the electricity bill for every time zone is stored. Since other composition is the same as that of a 1st embodiment, explanation is omitted.

[0035]Next, operation of such this embodiment is explained.

[0036]When the external power 50 transmits electricity bill system information, the communications department 25 receives this information and stores in the electricity bill system storage parts store 14 in the control section 10. The driving schedule preparing part 12 redetermines the driving schedule of the fuel cell 1 which made this the trigger and followed a new electricity bill system, when the contents of the electricity bill system storage parts store 14 change. For example, when it is predicted that the electric power supply of the external power 50 is tight in the daytime of summer, etc., the external power 50 transmits the electricity bill system which changed assigning the unit price of the electricity bill of daytime to the communications department 25 highly, or extending time zone width with a high unit price of an electricity bill etc. Then, a new electricity bill system is based, and the driving schedule preparing part 12 changes the time zone which sets the flag of not performing a purchased power, or makes change of time to store electricity the storage battery 4, and a change of the amount of accumulation of electricity.

[0037]When the external power 50 changes the unit price of an electricity bill by having composition of this embodiment by the above, the driving schedule of a fuel cell can be changed by a sex high instancey.

[0038]

[Effect of the Invention]So that clearly from the place explained above this invention, When a fuel cell and an external power are used together to an electric power supply, compare the unit price of the electricity bill in the case of carrying out a purchased power from an external power with the power generation unit price of a fuel cell, and one day is classified into three time zones according to the size, In a low electricity bill time zone, stop a fuel cell, and the generation output of a fuel cell is charged in a storage battery at an equivalent time belt, Since it determines that the driving schedule of a fuel cell will perform power load flattery operation, using the charge of a storage battery for a high electricity bill time zone without performing a purchased power from an external power, the control device of the fuel cell system which makes small the sum total of an electricity bill and a fuel gas fee can be provided.

[0039]By providing the communications department with an external power, an external power becomes possible [changing the driving schedule of a fuel cell by a sex high instancey], when the unit price of an electricity bill changes.

[Translation done.]

*** NOTICES ***

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1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.*** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The lineblock diagram showing the composition of the control device in the embodiment of the invention 1

[Drawing 2]The lineblock diagram showing the composition of the control device in the embodiment of the invention 2

[Drawing 3]The lineblock diagram showing the composition of the control device in the embodiment of the invention 3

[Drawing 4]The lineblock diagram of the art indicated to JP,6-325774,A public relations

[Description of Notations]

- 1 Fuel cell
- 2 Inverter
- 3 Power consumption measuring part
- 4 Storage battery
- 10 Control device
- 11 Control section
- 12 Driving schedule preparing part
- 13 Production-of-electricity unit price calculation part
- 14 Electricity bill system storage parts store
- 15 Fuel gas tariff structure storage parts store
- 16 Amount-of-used-electricity preserving part
- 19 Timer
- 20 Power load
- 21 Water-heating load
- 25 Communications department
- 30 Switch
- 31 Switch
- 32 Switch
- 50 External power

[Translation done.]